Cold Water Immersion

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Hypothermia

- Reduction of core temperature
- Blood is diverted from extremities to core
- Shivering increases heat production
- Energy stores eventually become depleted resulting in **metabolic fatigue** then eventually death
- Immersion in water causes significantly greater heat loss (24 x) compared to air and wind

What should I wear?

- T-6
- Day flight over water
- ~37 miles off the coast
- Air Temperature = 68°F
- Wind is 5 mph
- Lowest water temperature = 38°F
- Sea state = 3.0 ft waves
- SAR at NAS PAX = 2 Hotel

How long do I have?

- How long will it take for SAR to get to me if I end up in the drink?
- With my chosen anti-exposure gear, how long do I have to survive in water that is 38°F?

Variables Affecting Survival in Cold Water

1. Water temperature
2. Immersion time
3. Anti-exposure gear
4. Body Composition
5. Other
    1. Sea state
    2. Hydration/nutrition
    3. Injury
    4. Stress
    5. Fitness level

REF: Predicted Water Immersion Survival Times For Anti-Exposure Ensembles: Barry S. Shender, PhD and Wendy Todd. NAVAIR Human Systems Department.

Who has a better chance of survival?

Immersion without Anti-exposure Gear

Water Temperature	Exhaustion or Unconsciousness	Expected Survival Time
70–80° F	3–12 hours	3 hours – indefinitely
60–70° F	2–7 hours	2–40 hours
50–60° F	1–2 hours	1–6 hours
40–50° F	30–60 minutes	1–3 hours
32.5–40° F	15–30 minutes	30–90 minutes
<32° F	Under 15 minutes	< 15–45 minutes

REF: United States Search and Rescue Task Force

Cold Water Immersion Table

- Immersion table primary factors:
  - Water Temperature
  - Immersion time
  - Body Composition
  - Various configurations
- CWU-62/P dry suit
- CWU-23/P liner
- CWU-43 and 44/P underwear
- Other

Cold Water Immersion Table

15-18% Body Fat

Water Temp Fº	Dry Suit Only	Dry Suit + Liner	Dry suit + udrwr	ALL
35	≤60	≤90	≤105	≤195
40	≤60	≤105	≤135	≤255
45	≤90	≤150	≤180	≤315
50	≤105	≤195	≤225	>360
55	≤150	≤270	≤315	>360
60	≤210	≤360	>360	>360
68	≤360	≤360	>360	>360

Table: Minutes until metabolic fatigue *not* death

Here is the kicker….

- Table predicts for males only
- Sea state = 1-1.5 ft waves
- Assumes no injuries
- Does not take into account nutrition or hydration status
- Assumes non-damaged suit
  - Leaks
  - Inner tape pealing
- What if your LPU doesn’t inflate?
- What if you can’t get into the raft or you are flying the T-6?

Recommended Underclothing Based on Water Temperature

NAVAIR 13-1-6.7-2

Table 5-2. Recommended Underclothing Based on Water Temperature

Water Temperature	Recommended Underclothing
Above 60°F	CWU-43/P and CWU-44/P Aramid (Nomex) Cold Weather Underwear, Cotton Socks
50 to 60°F	CWU-43/P and CWU-44/P Aramid (Nomex) Cold Weather Underwear, CWU-23/P Liner or CWU-72/P Liner, Wool Socks
Below 50°F	CWU-43/P and CWU-44/P Aramid (Nomex) Cold Weather Underwear (two sets), CWU-23/P Liner or CWU-72/P Liner, Heavy Wool Socks
Note: For proper anti-exposure protection, a CWU-62/P Series Anti-Exposure Coverall must be worn over the recommended underclothing.	

PMA-202 Website

What would I wear?

- T-6
- 37 miles off the coast
- Air Temperature = 68°F
- Lowest water temperature = 38°F
- Sea state = 3.0 ft waves
- SAR at NAS PAX = 2 Hotel

How long do I have?

- How long will it take for SAR to get to me if I end up in the drink?
  - SAR 2 hotel = off deck **15-60** minutes
  - SAR travels ~37 miles to your position = **20-30** minutes
  - SAR gets to your position = **10-60+** minutes to spot you
  - Litter hoist = approximately **2-3** minutes
  - **~47-153 minutes**

How long do I have?

- With my chosen anti-exposure gear, how long do I have to survive in water that is 38°F?
  - 16% body fat
  - Dry suit = **≤ 60 minutes**
  - Dry suit and Liner = **≤ 105 minutes**
  - All = **≤ 255 minutes**
  - Sea state? Injury? Properly functioning suit?

I had 47-153 minutes.
Did I survive?

Summary

- Wear the anti-exposure configuration suited for:
  - coldest water you will be flying over
  - estimated rescue time based on SAR assets and mission range
    - 1 hotel = < 15 min off deck
    - 2 hotel = < 60 minutes off deck
    - 3 hotel = when they can get to you
  - Your body composition erring on the side of lean
- Get to your radio and signaling devices **ASAP**
- STAY STILL (H.E.L.P position)
- Keep your helmet on

Side Notes

- What offers better immersion protection when worn under the dry suit?
  - Liner
  - Long underwear
- OTS-600
- Late this summer, new model T-6s will have a raft
- T-6 retro fitting planned to start Spring of 2009

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Location	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
Montauk NY	36	35	38	46	54	62	70	70	66	57	56	43
Willets Point NY	35	34	39	49	59	66	71	73	69	59	54	42
The Battery NY	38	36	41	49	60	67	73	73	68	58	53	43
Sandy Hook NJ	37	36	40	48	58	63	71	72	66	57	51	43
Atlantic City NJ	37	35	42	50	58	64	70	73	67	58	53	44
Cape May NJ	37	37	42	51	62	69	74	73	70	58	52	42
Lewes DE	37	36	41	53	62	69	74	75	70	58	52	44
Ocean City MD	37	34	42	51	58	65	69	71	69	59	53	44
Cape Charles VA	36	39	46	56	66	69	77	77	74	61	54	44
Solomon's MD	37	37	43	55	66	75	81	84	73	61	57	45
Baltimore MD	40	37	43	57	67	75	78	79	72	61	54	43
Annapolis MD	36	35	42	54	63	74	78	77	71	60	53	45
Washington DC	37	37	46	61	71	79	83	81	72	58	52	41

Wearing Anti-Exposure Gear

- NATOPS 3710.7T
  - Water temp = **<50º F**
    - Latest available continuous or quick donning anti-exposure suits, as appropriate, shall be provided for flight personnel….
  - Water temp between **50º F - 60º F**
    - 3710.7T states “Final determination with regard to actual wearing of anti-exposure gear suits shall be made by CO or OIC of unit.
  - Water temp **<60º F** and no dry suit is required
    - Flight equipment ensemble shall include arimid undergarments
    - Undergarments for protection in dry environment

Wearing Anti-Exposure Gear >50°F

- Factors to consider listed by 3710.7T:
  - Aircraft (T6 no life raft!)
  - Mission duration
  - Mission Distance
  - Cockpit temps
  - Gear configuration
  - SAR Availability
  - Rescue time
  - Lowest water temperature

Hand Dexterity

- At 59 degrees F, hands begin to lose dexterity
- Numbness in hands occurs at 46 degrees C

Cold Water Immersion

- Physiology
  - Drop in core temperature
  - Blood vessels constriction
  - Loss of motor function starting in extremities
  - Shivering
  - Reduced cognitive ability
  - Shivering stops
    - body unable to regulate core temp
    - Metabolic fatigue
  - Death

Cold Water Immersion Table

- Limitations

1. Males only
2. Functional limits not death
3. 1-1.5 ft waves
4. Doesn’t take into account:
    1. Hydration/nutrition
    2. Injury
    3. Stress
    4. Fitness level
    5. Individual physiological differences

Summary

- **Flight factors:**
  - Water temperature
  - Mission duration
  - Mission Distance
  - Cockpit temps
  - Gear configuration
  - SAR Availability
  - Rescue time
  - Sea state
- **Physiological Factors:**
  - Water temperature
  - Immersion time
  - Body Composition
  - Hydration/nutrition
  - Heat stress
  - Injury
  - Psychological Stress
  - Fitness level

Example

- How long can you survive once in the water?
  - No raft
  - ~38 miles from coast
  - Water temperature = 40 degrees
  - Anti-exposure gear = dry suit and liner
  - 10% body fat
- What about sea state?
- Are you injured?
- Can you find or use rescue devices?
- SAR
  - 1 hotel = up to 15 minutes off deck
  - 2 hotel = up to 60 minutes until
  - 3 hotel = until they can get to you

Wearing Anti-Exposure Gear

- NAVAIR Human Systems Department
  - Dr. Shender and Wendy Todd
  - Studied several anti-exposure configurations
  - Various water temp
  - 1-1.5 foot waves
  - Males only
  - Various body types
  - Metabolic fatigue